Circular No. 7.

United States Department of Agriculture,

DIVISION OF BOTANY.

TUMBLING MUSTARD.

(*Sisymbrium altissimum.*)

Tumbling mustard, which has become very troublesome as a weed in the Canadian northwest Provinces during the past five years, has been recently reported from nine different localities in the United States. Its record in Canada and the rapidity with which it has already spread in some places in this country necessitate prompt action if its further progress is to be checked.

Fig. 1.—Tumbling mustard: *a*, base of stem of annual plant; *b*, leaf from lower part of main stem, reduced one-half; *c*, flower, twice natural size; *d*, branch with flowers and upper leaves, one-fourth natural size.

ORIGIN AND INTRODUCTION INTO AMERICA.

Tumbling mustard was early mentioned in botanical literature as occurring on the northern shores of the Mediterranean Sea and in southern Russia. It is now found throughout the greater part of Europe, northern Africa, and western Asia. During the past twenty years it has been spreading rapidly in Denmark and adjacent parts of northern Europe, while in some parts of Germany, Austria, and Russia it has long been a troublesome weed in cultivated fields and meadows.

The earliest authentic record we have of this species in America is a specimen in the National Herbarium, collected on ballast ground at Philadelphia in 1878. There are no indications that it ever spread from that locality. It is said to have been observed in 1883 along the tracks of the Chicago, Milwaukee

and St. Paul Railway at Sheffield, about five miles east of Kansas City, Mo. It seems to have spread slowly in that vicinity until within the last two or three years, and is yet confined to a comparatively small area. In 1892 it was observed at Aberdeen, S. Dak., and its abundance and distribution at that time indicated that it had been present there at least three or four years. In 1893 it was collected at Chicago, and at Weehawken, N. J.; in each case introduced along railroad tracks. In 1894 it was first observed at Minneapolis, and in 1895 it was collected at seven different points within ten miles of that city. It is most abundant about the elevators, indicating that it is probably introduced in impure seed which is cleaned in the steam-power cleaners. It was also found in 1895, at Davenport, Blue Grass, and Dickens, Iowa. At Dickens, in Clay County, it had spread for some distance along the Chicago, Milwaukee and St. Paul Railway.

The earliest authentic record of the tumbling mustard in Canada is based upon specimens collected in 1885, on the Canadian Pacific Railway, at the eastern base of the Rocky Mountains, in Alberta. It was found soon after this at several different points along the Canadian Pacific Railway, and had evidently been introduced in baled hay or in grain during the construction of that road. It grew with greater vigor and spread with greater rapidity in that region than it has at any point farther South. It is evidently well adapted to varying conditions, however, as it grows well on Vancouver Island, on the Pacific Coast; in Rogers Pass at the summit of the Selkirk Mountains, where it rains or snows nearly every day; across the dry plains of Assiniboia; at Port Arthur on the bleak northern shore of Lake Superior; and in the Southern parts of Ontario and Quebec. Its range so far as known at present extends from Rogers Pass, Castle Mountains, and Winnipeg on the north, to Sheffield, Mo., on the south, and from Danville, Quebec, and Wehawken, N. J., on the east, to Vancouver Island on the west. Temperature and moisture have not yet limited its range, and there is every reason to suppose that if left unchecked it will spread throughout all of the territory just marked out and dispute the possession of the land with ragweed, ox-eye daisy, and Russian thistle.*

NAMES AND DESCRIPTION.

This plant was first complained of in the vicinity of Indian Head and Qu'Appelle and is sometimes called "Indian Head tumbling weed" or "Qu'Appelle tumbling weed." In the vicinity of Aberdeen, S. Dak., it has been called "French weed" from the supposition that it was the French weed of the Red River Valley, which is pennycress (*Thlaspi arvense*). "Tumbling mustard" is the name most generally used and is the most appropriate, as the plant is a mustard and distributes its seeds by tumbling before the wind.

This species has been referred to in recent publications under the different technical names, *Sisymbrium altissimum* L., *S. pannonicum* Jacq., and *S. sinapistrum* Crantz. The best authorities now agree that all three names apply to but one species and call it by the name adopted by Linnæus—*S altissimum.*

* Tumbling mustard has probably been introduced in some places where it has escaped observation, or at least from which it has not been reported to this Department. If this, or any plant supposed to be this, should be found at any point in addition to those above mentioned, a specimen of the plant for identification, together with data in regard to its present distribution, and the time and manner of its introduction are desired, to be addressed to the Division of Botany, U. S. Department of Agriculture, Washington, D. C.

The tumbling mustard is an annual in Minnesota and the Canadian northwest Provinces and a biennial in Ontario and farther South. As a biennial, the seeds germinate in the summer or autumn, producing a rosette of root leaves similar to that of the dandelion or the shepherd's purse. The following spring a flower stalk grows up 2 to 4 feet high, usually much branched above, making a bush-like top. A small part of a flowering branch is shown at fig. 1, *d*, and part of a branch at maturity at fig. 2, *a*. The lower part of the stem bears numerous leaves 3 to 10 inches long and 1 to 3 inches wide (fig. 1, *b*). These leaves are deeply lobed, the lobes being wavy-margined or irregularly toothed and acute or pointed at the apex. The upper branching part of the stem (fig. 1, *d*) bears smaller leaves with narrow lobes, some of them almost thread-like. In May or June, light-yellow or nearly white blossoms, about one-third of an inch in diameter, smaller than those of the wild mustard but otherwise like them, appear in small clusters at the ends of the branches (fig. 1, *c*, *d*). The branches continue to grow, producing new buds and flowers in the center of each flower cluster, while the petals of the older flowers wither and fall, leaving slender pods scattered along the lengthening branch (fig. 1, *d*). The seeds in the earliest pods are mature about a month after the flowers appear, but the plant continues to bloom and produce pods until late in the summer. The mature pods are 2 to 4 inches long, and slightly curved, and are scarcely larger in diameter than the small stems on which they are borne (fig. 2, *a*). The surface of the pod is hard and smooth like that of the upper branches. The covering splits off in two strips and reveals a thick, white, spongy interior, on each face of which is packed a row of small, oblong, yellowish seeds.

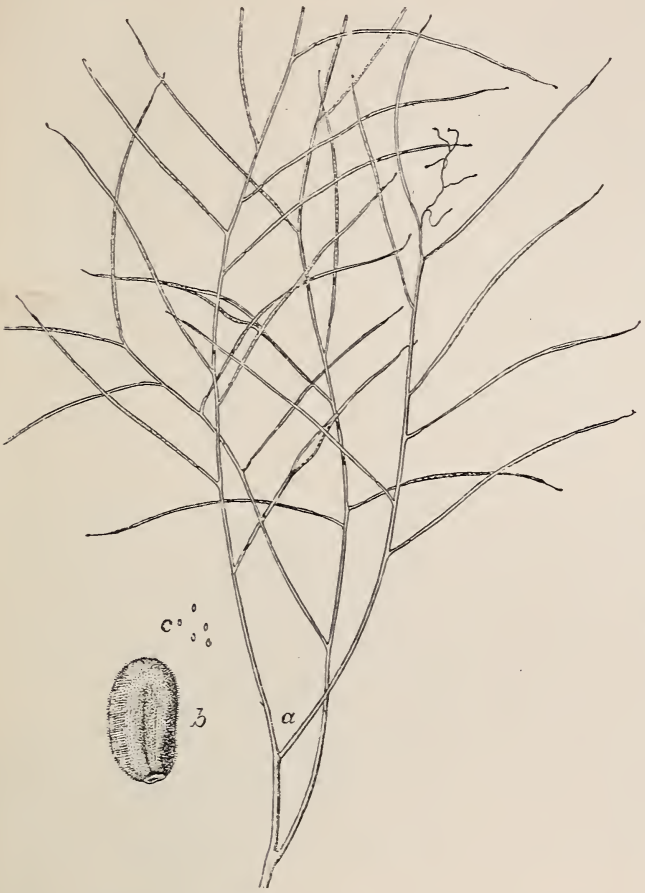

FIG. 2.—Tumbling mustard: *a*, branch of mature plant with pods, one-fourth natural size; *b*, seed, enlarged; *c*, seeds, natural size.

When the plant grows as an annual, as it does in the northern part of its range, the seed germinates early in the spring, producing the rosette of root leaves, from which the flower stem grows rapidly in early

summer. The flowers and pods follow in quick succession so that the greater part of the seed is mature by the time spring wheat is harvested. Most of the plants die early in September and none of them survive after the first severe frosts.

Seeds.—The seeds of the tumbling mustard are about 1mm. (1-25 inch) long and about one-half as thick. They are about the same length as the naked seeds of timothy, but are less pointed and not so thick at the middle. Although generally oblong in outline with rather blunt ends, they vary considerably, some having one scar or hollow extending half the length of one side, others having two nearly equal hollows on the same side, extending from opposite ends nearly to the middle, while still others have scarcely any hollow. In some the radicle is very prominent and straight, in others it is curved spirally around the cotyledons, and in some it is so nearly covered by the cotyledons as to be scarcely perceptible. Under the lens the seed coat usually shows fine transverse markings, and if soaked in water the seeds when magnified are found to be finely pubescent. The seeds are uniformly yellow-colored throughout, a few shades darker than the naked seeds of timothy.

RELATED WEEDS.

The best known relatives of tumbling mustard in this country are hedge mustard (*Sisymbrium officinale*), an annual introduced weed, common in waste land and along roadsides east of the Mississippi River; tansy mustard (*S. canescens*), an annual native weed often abundant in grain fields in the prairie region; and mouse-ear cress (*Stenophragma* [*Sisymbrium*] *thaliana*), an introduced winter annual or biennial which is becoming troublesome in early pastures in the Atlantic States.

As the character of a plant may often be judged by that of a closely related species, those to whom any of the above species are familiar have the means of judging of the characteristics of this species—the tumbling mustard.

METHODS OF DISSEMINATION.

Tumbling mustard is usually introduced into a new locality in baled hay, in poorly cleaned seed, in stock cars, or in the sweepings from grain cars. The individual seeds, or even the individual pods, will not be blown very far, as they are small and comparatively heavy for their size. But when the plant has once gained a foothold its seeds are scattered about by its rolling as a tumbleweed before the wind. The main stem becomes weak and brittle near the base and the bushy top with its many pods is easily broken off by the fall winds. An entire well-developed plant may travel several miles in a day before a strong wind on the open prairie. In places where there are trees, fences, or buildings the plants may travel a less distance, but they are likely to beat about with the varying winds and thoroughly seed the area infested. The hard covering of the seed pod splits off slowly under the action of the weather so that the seed is dealt out somewhat sparingly as the plant travels along, and some seeds may be found even on branches that have been buffeted about all winter. The efficacy of its means of dissemination is evidenced by the remarkable increase and rapid dispersion of this weed in some localities.

A well-developed annual plant of tumbling mustard 4 feet high, collected in Assiniboia in 1892, was carefully examined by Prof. James

Fletcher, of Ottawa, Canada, who found that the pods contained an average of 120 seeds each, and that the whole plant bore 12,500 pods making a total of 1,500,000 seeds. Although specimens as large and thrifty as this one are not uncommon (under favorable conditions in the region where it is best suited), probably not more than one-third that number of seeds is borne by the average plant.

POINTS OF DANGER.

The present geographical distribution of this weed as indicated on the map (by black dots), together with the methods by which its seeds are known to be disseminated, indicate certain points of danger which should be carefully guarded.

The plant is likely to be found along railroads, especially along roads hauling freight from the infested localities. Along these roads it is most

FIG. 3.—Map showing distribution of tumbling mustard so far as known May 25, 1896. (Rogers Pass and Castle Mountain, in Alberta, are beyond the limits of the map.)

likely to be found at grain elevators, stock yards, sidings, and places where stock cars are cleaned. These situations should be watched in June for the dull yellow blossoms and divided thread-like upper leaves.

Probably the most dangerous agency in the introduction of tumbling mustard is baled hay. This is most dangerous because it is most difficult to guard against. The use of immense quantities of Western hay during the past year in consequence of the short hay crop in the East has convinced the Eastern consumer of the superior quality of prairie hay over the cheaper of the home grades. With the use of this hay there is certain to be an introduction of Western weeds. Almost the only way to guard against them is carefully to watch and destroy all strange weeds that appear about the feeding places and in the fields fertilized with manure from stock fed with imported hay. In some cases it may be practicable to pick out and burn the most conspicuous weeds when

the bales are broken. An Eastern market for a fancy grade of hay could doubtless be worked up by removing the weeds before the hay is baled in the West and guaranteeing it free from noxious weeds.

Seeds of tumbling mustard are likely to be introduced with commercial seeds grown in the infested regions. Though the seeds are so small that they can be removed from flax and grain seed, they are likely to be found in poorly cleaned qualities. A careful watch should therefore be kept about mills and elevators where these seeds are recleaned. Under no conditions should seed brought from infested regions be sown unless it is known to be thoroughly cleaned.

WARNING TO SOUTH DAKOTA TIMOTHY SEED GROWERS.

Seeds of the size of naked timothy seed are the most likely to contain seeds of tumbling mustard as an impurity. Timothy seeds inclosed in the glumes, as they are ordinarily found, are somewhat larger than the tumbling mustard seed, but the difference is not sufficient to enable them to be separated on a large scale either by screens, fans, or suction. A large proportion of the timothy seed used in this country is grown in the Sioux Valley in the eastern part of South Dakota. Fortunately the tumbling mustard has not yet infested this valley, and it is hoped that it may be kept out, for should it be allowed to spread in the timothy fields for only two consecutive years, it would probably ruin the timothy seed industry of that entire section. Guarding against introduction in this case will be found more economical than subsequent eradication. If the weed should make its appearance it will demand a prompt application of the treatment recommended below, whether along the roadsides, on one's own farm, or on those of indifferent neighbors.

METHODS OF ERADICATION.

Where the tumbling mustard has been introduced an effort should be made to eradicate it completely. Complete eradication seems to be practicable now, and if it is possible it is certainly cheaper than a half-hearted warfare and in every way preferable.

In this country the plant is thus far confined chiefly to waste land about cities and villages, along railroads, and along roadsides. Mowing these places three times (in June, July, and August) will prevent the growth of plants large enough to blow about as tumbleweeds. It is not likely to exterminate them, however, as branches will grow out and bear seeds below the reach of the scythe or mowing machine. Mowing is recommended if nothing better can be done, as it will keep the plants in check and prevent them from spreading to any great extent.

A better method is to pull by hand or grub out all plants found during the last two weeks of June and again about the middle of August. The land would have to be worked over in this manner two or three years in succession, as the seeds undoubtedly would not all germinate in one season in uncultivated ground. Where the harrow can be used to advantage along roadsides and on waste ground the labor of eradicating the weeds can be greatly reduced by harrowing the land thoroughly at frequent intervals during the summer and then seeding with sod-forming grasses. Especial attention is directed to waste ground, vacant city lots, and roadsides, because these are the places where the tumbling mustard is now most abundant and these are the places where our most noxious introduced weeds first secure a foothold.

In cultivated fields where tumbling mustard has become established it can best be eradicated by cultivation. If only a few plants are found in a pasture or meadow, it may be more economical to pull them by hand, as in waste land. The place should be watched three or four years, however, in order to prevent the growth of plants from seeds that have lain dormant.

Frequent stirring of the soil will induce germination of the seeds and kill the plants as they grow, so that most of them may be destroyed in a single season. Summer fallowing is therefore one of the most effective methods of destruction. Nearly as good results may be obtained, by preparing the ground thoroughly and planting corn, potatoes, beans, turnips, or any crop that will pay for thorough cultivation. This method is strongly recommended, as the extra work will be amply paid for by the increased crop and the improved condition of the soil. The cultivation should be continued as long as the condition of the crop will warrant; and where the climate and other conditions will admit, it is well to sow rye or some other hardy winter grain to choke out the growth of winter weeds, like penny cress, shepherd's purse, and false flax. The rye will afford good pasture and should be plowed under in the spring.

A piece of land near Aberdeen, S. Dak., was cleared of the tumbling mustard in the following manner: It was plowed late in the spring and sowed to millet. The millet was cut for hay before harvest and the land plowed immediately. This plan is earnestly recommended where it is impracticable to keep the cultivator going in hoed crops, but some of the mustard seeds are likely to lie dormant while the millet is growing and thus escape destruction. In wheat and other grain crops the tumbling mustard may be destroyed to a considerable extent by the modern horse weeders. In winter wheat especially, the use of the weeder in the spring will greatly improve the crop and will destroy immense numbers of annual weeds. This tool may also be used to advantage in hoed crops between the time of seeding and the first cultivation. Plants that escape the weeder and grow up in the grain should be pulled while in blossom.

Fields that are infested with tumbling mustard should be burned over, or at least the mature seed-bearing plants should be burned, before plowing. The first plowing should be shallow so as not to cover too deeply seeds that have escaped the fire. Before sowing small grain this upper layer of soil should be thoroughly cultivated to induce the germination of the mustard seeds and destroy the young plants.

COMPLETE ERADICATION POSSIBLE.

The plant is still confined to a small area in this country, chiefly consisting of vacant lots and waste land about cities and villages. If it is earnestly attacked, it can be readily destroyed in these places at comparatively slight expense, and we may be entirely rid of the plant before it has inflicted any material injury. We should profit by the experience of the people of Assiniboia, whence this plant has been supposed to come, as they are profiting by our experience with the Russian thistle, which they have received from us. About ten years ago the people about Indian Head, Assiniboia, were warned of the dangerous character of tumbling mustard and advised to eradicate it before it had spread farther. They did not heed the warning, however, until the

weed had invaded their fields and injured their crops. Then they began to fight it, and last year (1895) in that one locality 1,200 acres of tumbling mustard were plowed under to prevent it from seeding, and many acres which otherwise would have produced paying crops were kept in barren fallow.

Since the people of Manitoba, Assiniboia, and Alberta, in Canada, have begun such an active warfare against this weed, there is less danger in future from the introduction of seed from that source. It has now but a slight foothold in this country, and it can be and should be completely eradicated from these places before it has spread any farther.

PROSCRIBED BY LAW IN MINNESOTA.

An act passed by the Legislature of Minnesota and approved April 25, 1895, provides severe penalties for permitting tumbling mustard to produce seed in that State or permitting it to grow two consecutive years on the same land.

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Approved:
J. STERLING MORTON,
Secretary of Agriculture.

WASHINGTON, D. C., *June 5, 1896.*